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STUDYOFTHEQUALITY OFUNDERGROUNDWATEROFDISTRICTDGKHANSOUTHERNPUNJABPAKISTAN

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I. Introduction

The existence of life depends on water. Life without water cannot be expected and is thought to be impossible. It is the main necessity of the whole world. Water exists naturally in two forms, surface water and groundwater. Groundwater plays an important role for irrigation and live stock purpose. Groundwater is the mixture of various contents because it passes through the underground rocks and during its passage it combines with different substances, which makes it favor for various serving purposes (Ramkumar et al., 2009). The assessment of irrigated water depend on the composition of salt and salt inducing body, presence the plenty of micro and macro nutrients, trace elements, alkalinity, acidity, stability and the amount of suspended solids (U.S. Salinity Laboratory Staff, 1954; Ajayi et al. 1990). However Irrigated water brings some dissolved salts from sources (Michael, 1985). The quality and quantity of these dissolved salts depend on the source. Usually most water dissolved substance include sodium (Na^{+}), magnesium (Mg^{+2}), calcium (Ca^{+2}), sulphate ($SO4^{+2}$), nitrate ($NO3^{-1}$), chloride (Cl^{-}), boron (Br), carbonate ($CO3^{-2}$) and bicarbonates ($HCO3^{-2}$). The amount and concentration of these dissolved ions determine the fitness of water for irrigation (Ajayi et al., 1990).The common quality parameters are Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC). Chemically irrigated water affect the growth of plant directly (toxicity or deficiency) or indirectly by altering the composition of plant nutrients. (Ayers and Westcot, 1985; Rowe et al., 1995).Climatic change also influence the good quality of irrigated water from humid to arid conditions. Salts are originated from weathering of rocks and soil, including dissolution of lime, gypsum and other slowly dissolved soil minerals. These substances are transferred from water resource to wherever it is used (UCCC, 1974; Tanji, 1990). Sufficient supplies of useable quality water would increase the requirement of irrigated agriculture. Lower quality of irrigated water adversely affects the production rate of crops (Bello, 2001). But unfortunately quality of irrigated water should be deserted (Shamsad and Islam, 2005; Islam et al., 1999). Due to various factors the surface water resources of Pakistan has been reduced down about 70% (Kahlown et al., 2003). Unfortunately, canal water is inadequate to meet the requirement of crops under severe harvesting system in Punjab (Ahmad and Chaudhary, 1988; Ahmad et al., 2007). For this requirement, there were about 250,000 public and 350,000 private tube wells working in various irrigated parts of country in the year 2000 (Alam, 2002). In which more than 70% are of poor quality (Qureshi and Barrelt-Lennard, 1998).

Keeping in view the importance of irrigation water quality, the present study was contemplated with the following objectives. i) to ensure the quality of tubewells water for irrigation and ii) suggest the different option to improve the adverse effects of poor quality of irrigation water on soil and crop yields on the command area of district Dera Ghazi Khan.

II. Materials and Methods

a) *Description of study area*

Dera Ghazi Khan District is situated between river Indus and Suleiman range and lies between 20.40 North and 70.75 East. The total geographical area of the district is 4.07 million hectares out of which 2.36 million hectare area is cultivated while 68.03 hectare under forest and the rest are either not available for cultivation or cultural waste. Out of the cultivated area of 7, 15,846 hectares are canal irrigated and rest is barren. The

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climate of district is dry with very little rain fall. The winter is cold and summer is very hot. The annual rainfall in the district is insufficient.

b) Water sampling

To achieve the goal of this research, the study was revealed in the Soil and Water Testing Laboratory for Research Dera Ghazi Khan having two Tehsils (Tehsil D.G. Khan and Tehsil Taunsa Sharif). The water samples were collected from different tubewells using GPS. The samples were collected in plastic bottles after the 30 minutes operation of tubewells. The water samples were collected at the depth of 80-250 feet.

c) Water analysis

The water samples were analyzed at Soil and Water Testing Laboratory for Research, Dera Ghazi Khan for electrical conductivity, cations (Ca+2+ Mg+2, Na+) and anions (CO3-2, HCO3-1 and Cl-1) by the methods described by Page et al.,(1982). Residual sodium carbonates (RSC) and Sodium Adsorption Ratio (SAR) were calculated according to the procedure described by Washington DC Method (1954). The collected water samples were analyzed on the basis of following criteria regarding their suitability for irrigation purpose.

d) Water quality criteria

Table 1 : Criteria of parameters used for water analysis

Parameters	Fit	Marginally fit	Unfit
EC (µS/cm)	0-1000	1000-1250	>1250
SAR	0-6	6-10	>10
RSC (meq/L)	0-1.25	1.25-2.50	>2.50

e) Results

Table 2 : Range, mean and standard deviation (SD) of cations, anions and irrigated water quality parameters of district D.G Khan (Tehsil D.G Khan & Tansua sharif)

Tehsil		EC (µS/cm)	Ca + Mg (meq/L)	Na (meq/L)	CO_3^{-2} (meq/L)	HCO_3^{-1} (meq/L)	Cl^{-1} (meq/L)	SAR	RSC meq/L
D.G. Khan	Range	70-999	0.19-9.92	0.0-9.90	0.02-11.3	0.04-9.90	0-9.69	0.02-9.57	0.01-10.3
	Mean	1130.448	7.602665	3.997104	1.344567	6.056278	3.310596	2.07355	1.379247
	SD	715.8134	14.36571	3.599562	1.237315	9.055964	4.366961	1.373505	1.116693
Taunsa Sharif	Range	201-9900	1.02-9.80	0.1-9.90	0.08-3.69	0.1-3.50	0.1-7.3	0.8-8.96	0.0-12.78
	Mean	1582.438	10.84279	5.267601	1.133859	8.278326	4.922256	2.360902	2.556875
	SD	1032.563	20.06196	4.92646	0.608702	4.914243	15.56307	5.526436	3.770826

Table 3 : Classification of water sample on the basis of EC (µS/m) in Tehsil D. G. Khan and Tehsil Taunsa Sharif

Sites	Total Samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D.G. Khan	16555	10034	60	934	6	5587	34
Taunsa Sharif	5497	1598	29	221	4	3678	67

On the basis of RSC water samples show highly fitness. In Tehsil D.G. Khan about 99% were fit, 0.59% were marginally fit and just 0.30% were found unfit. Similarly, same behavior was observed in Tehsil Taunsa Sharif, which indicated 99.9% fit, only 0.01% marginally fit and 0.09% were unfit. (Table 4)

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Table 4 : Classification of water sample on the basis of RSC (meq/L) in Tehsil D. G. Khan and Taunsa Sharif

Sites	Total Samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D.G. Khan	16555	16406	(99)	98	(0.59)	51	(0.30)
Taunsa Sharif	5497	5491	(99.9)	1	(0.01)	5	(0.09)

On SAR basis it was noted that in Tehsil D.G. Khan 98% samples were fit, 1.50% were marginally fit and 0.19% samples were observed unfit. Correspondingly same results were found in Tehsil Taunsa Sharif , it showed that 97% were fit, 1.80% were marginally fit and 0.56% were examine unfit.(Table 5)

Table 5 : Classification of water sample on the basis of SAR in Tehsil D. G. Khan and Taunsa Sharif

Sites	Total samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D. G. Khan	16555	16299	(98)	244	(1.50)	32	(0.19)
Taunsa Sharif	5497	5367	(97)	99	(1.80)	31	(0.56)

Finally classifying the water samples on the three quality parameters EC (µS/cm), RSC (meq/L) and SAR in tehsil D.G Khan and Tansua sharief following result were set up in table 6. It point out that 60.60% water samples were consider fit, 5.65% marginally fit and 33.75% unfit respectively. In tehsil tansua sharif 29.075 samples were fit, 4.02% were marginally fit and 66.91% checked unfit (table 6).

Table 6 : Classification of water sample on the basis of EC (µS/cm), RSC (meq/L) and SAR in Tehsil D. G. Khan and Taunsa Sharif

Sites	Total samples	Fit		Marginally fit		Unfit	
		Samples	% age	Samples	% age	Samples	% age
D.G Khan	16555	10032	(60.60)	935	(5.65)	5588	(33.75)
Taunsa Sharif	5497	1598	(29.07)	221	(4.02)	3678	(66.91)
	22052	11630	(52.73)	1156	(5.24)	9266	(42.01)

III. Discussions

The quality of ground water for agricultural use was the main concern of this study. On the basis of classification, the analytical data shows that 34 % and 67 % water samples were found to be unfit due to EC in Tehsil D. G. Khan and Tehsil Taunsa Sharif, respectively containing high content of soluble salts. But in case of SAR only few water samples (0.19% and 0.56%) of both Tehsils were found to be unfit (Table 5). Regarding RSC same trend was found in both Tehsils (Table 4). On over all basis it was noted that all the three parameters are considered to see the fitness of the quality status of underground water. In both of the Tehsils, it was observed that 42 % tube wells were delivering poor quality of water and ultimately causing gradual increase of deposition of salts and deteriorating the soil health as well as crop quality and yield (Table 6). Some investigations revealed that poor quality of water exerted hazardous effects on soil quality, soil fertility and ultimately on plant health. There are many factors that are responsible for salinity of ground water, including climate of that region, soil type and the amount of precipitation. Generally these problems occurred in tropical region where annual rainfall is infrequent. Due to low precipitation amount of salts increased in these regions.

IV. Recommendations

So keeping in view the gravity of the problems using poor quality water it is strongly recommended that either canal water should be mixed with such waters before use or such waters must be treated with certain suitable amendments such as gypsum or sulfuric acid in order to maintain soil health on sustainable basis for better crop yields.

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